BACKGROUND

California is subject to severe earthquake induced ground shaking, liquefaction, landslides and other ground failures that have caused deaths and tremendous economic losses. Regulations regarding earthquakes have been revised and updated to reduce such losses. In 1990, the State Legislature passed the Seismic Hazards Mapping Act (SHMA) to identify and map Seismic Hazard Zones such as Liquefaction and Landslide areas and to mitigate seismic hazards to protect public health and safety.

APPLICABLE PROJECTS

An affected project is defined as any structure for human occupancy or any subdivision of land that contemplates the eventual construction of structures for human occupancy, located within the Seismic Hazard Zones. A structure for human occupancy is defined as any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person hours per year.

Exception:

1. *SFD not exceeding two stories when the dwelling is not part of a development of four or more dwellings.*
2. *Alterations and additions to any structure not exceeding either 50% of the value of the structure or 50% of the existing floor area of the structure.*

REQUIREMENTS

If your project as defined above is in the Seismic Hazard Zone, the Seismic Hazard Mapping Act requires the submittal of a soils/geology report and this report must be reviewed by an independent third party (City Soils Engineer or Geologist). For a liquefaction investigation, at least one boring shall be minimum of 50 feet in depth. (More than one 50 feet boring might be necessary based on size of lot, and soils conditions.) This requirement may be waived if it can be documented that 1) historic high groundwater elevation is in excess of 50 feet below lowest proposed grade and 2) it is not feasible for the groundwater elevation to rise to within 50 feet of lowest proposed grade during the life of the structure.

CONTENT OF REPORTS

The site investigation report should contain sufficient information to allow the lead agency's technical reviewer to satisfactorily evaluate the potential for seismic hazards and the proposed mitigation(s). The following list is provided to assist investigators and reviewers in identifying seismic hazard-related factors significant to the project. Not all of the information in the list will be relevant nor required, and some investigations may require additional types of data or analyses.

RECOMMENDED CONTENT FOR SITE-INVESTIGATION REPORTS WITHIN ZONES OF REQUIRED INVESTIGATIONS

Reports that address liguefaction and/or earthquake-induced landslides should include, but not necessarily be limited to, the following data:

1. Description of the proposed project's location, topographic relief, drainage, geologic and soil materials, and any proposed grading.
2. Site plan map of project site showing the locations of all explorations, including test pits, borings, penetration test locations, and soil or rock samples.
3. Description of seismic setting, historic seismicity, nearest pertinent strong-motion records, and methods used to estimate (or source of) earthquake ground-motion parameters used in liquefaction and landslide analyses.
4. 1:24,000 or larger-scale geologic map showing bedrock, alluvium, colluvium, soil material, faults, shears, joint systems, lithologic contacts, seeps or springs, soil or bedrock slumps, and other pertinent geologic and soil features existing on and adjacent to the project site.
5. Logs of borings, test pits, or other subsurface data obtained.
6. Geologic cross sections depicting the most critical (least stable) slopes, geologic structure, stratigraphy, and subsurface water conditions, supported by boring and/or trench logs at appropriate locations.
7. Laboratory test results; soil classification, shear strength, and other pertinent geotechnical data.
8. Specific recommendations for mitigation alternatives necessary to reduce known and/or anticipated geologic/seismic hazards to an acceptable level of risk.

Reports that address earthquake-induced landslides may also need to include:

1. Description of shear test procedures (ASTM or other) and test specimens.
2. Shear strength plots, including identification of samples tested, whether data points reflect peak or residual values, and moisture conditions at time of testing.
3. Summary table or text describing methods of analysis, shear strength values, assumed groundwater conditions, and other pertinent assumptions used in the stability calculations.
4. Explanation of choice of seismic coefficient and/or design strong-motion record used in slope stability analysis, including site and/or topographic amplification estimates.
5. Slope stability analyses of critical (least-stable) cross sections which substantiate conclusions and recommendations concerning stability of natural and as-graded slopes.
6. Factors of safety against slope failure and/or calculated displacements for the various anticipated slope configurations (cut, fill, and/or natural slopes).
7. Conclusions regarding the stability of slopes with respect to earthquake-induced landslides and their likely impact on the proposed project.
8. Discussion of proposed mitigation measures, if any, necessary to reduce damage from potential earthquake-initiated landsliding to an acceptable level of risk.
9. Acceptance testing criteria (e.g., pseudo-static factor of safety), if any, that will be used to demonstrate satisfactory remediation.

Reports that address liquefaction hazards may also need to include the following:

1. If methods other than Standard Penetration Test (SPT; ASTM D1586-92) and Cone Penetration Test (CPT; ASTM 3441-94) are used, description of pertinent equipment and procedural details of field measurements of penetration resistance (borehole type, hammer type and drop mechanism, sampler type and dimensions, etc.).
2. Boring logs showing raw (unmodified) N-values if SPT's are performed; CPT probe logs showing raw q_c-values and plots of raw sleeve friction if CPT's are performed.
3. Explanation of the basis and methods used to convert raw SPT, CPT, and/or other non-standard data to "corrected" and "standardized" values.
4. Tabulation and/or plots of corrected values used for analyses.
5. Explanation of methods used to develop estimates of field loading equivalent uniform cyclic stress ratios (CSR_{eq}) used to represent the anticipated field earthquake excitation (cyclic loading).
6. Explanation of the basis for evaluation of the equivalent uniform cyclic stress ratio necessary to cause liquefaction (CSR_{liq}) within the number of equivalent uniform loading cycles considered representative of the design earthquake.
7. Factors of safety against liquefaction at various depths and/or within various potentially liquefiable soil units.
8. Conclusions regarding the potential for liquefaction and its likely impact on the proposed project.
9. Discussion of proposed mitigation measures, if any, necessary to reduce potential damage caused by liquefaction to an acceptable level of risk.
10. Criteria for SPT-based, CPT-based, or other types of acceptance testing, if any, that will be used to demonstrate satisfactory remediation.

Note: This table is from Special Publication 117, "Guidelines for Evaluating and Mitigating Seismic Hazards in California.

Field work, Data, Liquefaction analysis techniques, and results of such will be reviewed in accordance with the following:

- California Division of Mines and Geology, 3/13/97, Guidelines for Evaluating and Mitigating Seismic Hazards in California
- Southern California Earthquake Center, 3/99, Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction Hazards in California, SCEC Contribution Number 462.
- National Center for Earthquake Engineering Research, 12/31/97, Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Technical Report NCEER-97-0022.
- Review criteria may be revised as new research or other information becomes available.